Upcoming 2020 improvements for RCT team

- Still trying to make a robot able to play games!
  - Learning form other teams...

- New features:
  - Improved coil gun.
  - Improved propulsion structure
  - Reliable embedded processing architecture
  - Reliable sensors
    - Cameras
    - Lidars

- New robots:
  - New ball handling system
Introducing a multi-coil kicking system:

- Same copper weight
  - Old one: 1 coil
  - New one: 4 coils

- Same overall capacitor value
  - Old one: one 4700uF 450V capacitor
  - New one: four 1200uF 450V capacitors
Modelling a kicking system under Matlab Simulink:

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Finite element generated lookup tables
Power conversion simulations:

- Capacitor energy: $E_c = 450\text{J}$
  - Equivalent mass for plunger + ball + vertical bar: 0,7kg
  - Theoretical ball speed in a perfect energy transfer: $35.8\text{m.s}^{-1}$ ($126\text{ km.h}^{-1}$)

- Simulated output ball speed with one coil:
  - $11\text{m.s}^{-1}$ ($40\text{ km.h}^{-1}$)
  - $E_c = 42\text{ J}$
  - Energy transfer: 9.3%

- Simulated output ball speed with four coils:
  - $17\text{m.s}^{-1}$ ($61\text{ km.h}^{-1}$)
  - $E_c = 101\text{ J}$
  - Energy transfer: 22.4%
Simulations: One coil VS Four coils

Final speeds: One coil: 11 m.s⁻¹ VS Four coils: 17 m.s⁻¹
Multi-coil kicking system: results

- **Hypothesis:**
  - No change in copper weight or capacitor overall value

- **Results:**
  - Improves energy transfer by a factor 2.4.
  - Still to improve (power transfer of only 22%)

- **We will use at RoboCup 2020**
  - Kicking system PCB operational
    - In production now.
  - Based on TUe circuit
    - Small evolutions for safety in case of short circuits.
Introducing a new omni-directional mirror

- Evolution of our non distorting mirror
  - Already presented in 2019
  - A square in the horizontal plane has the same size on the image, whatever its position in the scene.

- Introducing a bi-foveal mirror
  - Double non-distorting mirror
  - See the whole field
  - See precisely around the robot
Introducing a different robot configuration

- 4 omni-wheels in a pentagonal structure
  - More power during acceleration
  - Very large free area in front of the robot
    - 144° in a pentagonal structure
    - 120° in a triangular structure

- A difficulty
  - Hyperstatism due to the fourth wheel
    - Using suspended wheels mounted on rubber.
Introducing a new ball handling system

- Large ball handling system
  - Take advantage of the large opening angle of the pentagonal base structure
- Using 6 mecanum wheels
  - Inspired by Water team
  - Grip of the mecanum wheels
  - Auto-centering of the ball
    - Necessary with a wide opening angle
- Has to be tested extensively
  - We will report videos as soon as possible.
    - Instagram: #robotclubtoulon

RoboCup MSL Workshop 2019
Robot Club Toulon
Sensor and Embedded system evolution

- Using GTX 1060 GPU for computer vision (Neousys computers)
- Using Basler cameras with Gbit Ethernet and PoE.
- Using Lidars for collision avoidance
  - Studying the possibility of using a 50Hz – 0.014° resolution LIDAR
  - Precision: points every 2.5mm at 10 meters.
Thanks for your attention

Questions?